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Newsletter of the North American Mycological Association

THE MYCOPHILE

PRESIDENT'S MESSAGE By Bob Fulgency

Members have on occasion expressed an interest in the financial affairs of NAMA, particularly how funds are allocated. NAMA's finances are pretty much straight forward and fairly simply to explain. NAMA's income comes from three main sources: 1) dues, contributions and donations; 2) forays; and 3) interest and dividend income from investments. The funds are distributed among two sub-funds: Program Services and Administrative Services both established by the Board of Trustees. Program Services are those activities that are assigned to NAMA's committees or other missions, while Administrative Services consist of those activities directly involved in NAMA operations. As for Program Services, some of the larger committees have been given extensive responsibilities, while other smaller ones have more limited tasks. For allocation purposes, Program Services committees and other missions are grouped as follows:

Program Services

Arts & Graphics Committee
Archives
Awards Committee
Cultivation Committee
Directory
Dyeing & Papermaking Committee
Editorial Committee
Education Committee
Finance Committee
Foray Committee
Inter- Society Liaison Committee
Literature Committee
Marketing Committee
McIlvainea
Medicinal Mushroom Committee
Mycophagy Committee
Mycophile
Nominating Committee
Photography Committee
Sponsoring Foray Endorsement
Toxicology Committee
Voucher Committee
Website Committee

Meanwhile, operational expenses for Administrative Services are allocated as follows:

Administrative Services

Executive
Secretary Expenses
Executive Secretary Stipend
Membership Committee
President's Expenses
Secretary's Expenses

The allocation of funds to most of the committees and services varies from very modest amounts to nothing at all. NAMA is fortunate in having a large number of members who volunteer their time and often their money to support many of the club's ongoing functions. Currently, the bulk of the funding goes to five Program and Administrative Services: (1) Executive Secretary; (2) Mycophile; (3) Voucher Committee; (4) Inter-Society Liaison Committee; and (5) Foray Waivers. Here is an overview of each of these programs:

(1) The Executive Secretary is NAMA's majordomo, having responsibility for overseeing the day-to-day routine of the club as well as other important activities. It is a demanding position and we are fortunate to have had--over the years-- individuals who have been willing to take on this important post for a limited stipend.

(2) The majority of the Mycophile newsletters are now distributed electronically at a substantially reduced cost; however, a few--less than twenty percent of the total--are still printed in hard copy and distributed by mail.

(3) The Voucher Committee is in charge of gathering, identifying, photographing, preserving and maintaining the mushroom specimens collected during the annual forays. These specimens and related materials represent an important resource for the scientific study of mycology and are currently kept at the renowned Field Museum in Chicago. Until the Field revamps its website, the NAMA collections over last two years can be seen on the Mushroom Observer website:

http://mushroomobserver.org/project/show_project/21

(4) The Inter-Society Liaison Committee annually awards a NAMA Memorial Fellowship to a promising doctoral-degree mycology student. The Mycological Society of America, with NAMA's consultation, selects the student.

(5) Annual Foray waivers are given to NAMA officers attending the foray and the Trustee Meeting in return for performing duties necessary for NAMA's continued operation. These include administering: membership, finance, committees, and corporate records; as well as fostering growth and development of the club.

I am pleased to report that NAMA at this time is on solid financial footing and with wise oversight and management, will continue to be so for many years to come. For those interested, the official financial report will be available in December following the Trustee Meeting in California.

The Marketing Committee, charged with the duty to promote NAMA and increase membership, has been very active the last few months. The committee has come up with several innovative strategies to attract new members, thanks to the creative work of John Plischke and David Rust. As an example, it has recently completed surveys of current and past members to gather information on how NAMA can better serve its membership; as a further example, it has arranged for a complimentary copy of the Mycophile--with promotional materials soliciting NAMA membership included--to be delivered to affiliated club members.

In closing, there is one more thing I would like to pass on. And it is that some affiliated club members may be forwarding copies of current Mycophiles to all fellow members. If this is indeed the case, I would very much like to see this activity discontinued. It is not only unfair to our dues paying members, but if this practice were to become widespread, it would damage NAMA by devaluing its membership. One of the great benefits of being a member of NAMA is receiving bimonthly issues of the Mycophile; however, if an individual could receive this benefit without paying membership dues, it would be a significant disincentive for that individual to join NAMA.

Lastly, by now many of you may be aware of the tragic passing of Patrice Benson this past July. Patrice was a dedicated member of NAMA and served it in many important roles, including being a member of the Executive Committee, Marketing and Foray Committees and a Region IX Trustee; in addition to these duties, she had been heading up the planning and preparation for the 2014 NAMA Annual Foray to be held in Washington State. For an excellent review of her many accomplishments, I refer you to the page 13 of this issue.

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The Mycophile Editor: Dianna Smith
diannasmith@optonline.net

North American Mycoflora Organizational Meeting a Tremendous Success

By David Rust

As we gathered for the first North American Mycoflora workshop in mid-July in New Haven, Connecticut, it quickly became apparent that this was going to be an epic meeting, with 70 of the top names in mycology in attendance. Lining up for breakfast at the hall beforehand, everyone had big smiles, seeing old friends for the first time in years, chatting up a storm and stuffing in the eggs, potatoes and coffee as fast as they could, and getting ready to tackle the biggest project in mycology in their lifetime. Assembling a mycoflora of North American fungi is a very ambitious project.

Attendees of the first North American Mycoflora workshop, Yale University, July 2012 © photo by Tom Bruns & Dimitar Bojantchev
***Front row** (seated): Scott Redhead, Patrick Leacock, Todd Osmundsen, Matt Smith, Sarah Hicks, Alija Mujic, Vinson Doyle, Nhu Nguyen, David Arora, Karen Hansen, Rick Kerrigan, Maj Padamsee, Jean Bérubé, Alma Rodriques Estrada, De-Wei Li, Alissa Allen, Greg Mueller*
***Back row** (standing): Rod Tulloss, Erik Lilleskov, Scott Bates, Brandon Matheny, ??, Bill Neill, Debbie Viess, David Rust, Bill Yule, Nathan Wilson, Betty Strack, Mia Maltz, Mike Wood, Alisha Owensby, Roy Halling, Karen Nakasone, Terry Henkel, Barbara Thiers, Andy Wilson, Cathy Aime, John Pickering, Lawrence Millman, Tim James, Gary Lincoff, Henning Knudsen, David Lewis, Sharon Cantrell, Matteo Garbelotto, Bob Mara, Ron Peterson, Eric Walberg, Leon Shernoff, Andy Methven, Steve Trudell, Karen Hughes, Lorelei Norvell, Jean Lodge, Meredith Blackwell, David McLaughlin, Anna Gerenday, Rosanne Healy, Jeremy Hayward, Else Vellinga, Noah Siegel, Christian Schwarz, Jen Walker, Michael Castellano, Alfredo Justo, Tom Horton, Bart Buyck, Tom Bruns, Dimitar Bojantchev*

UC Berkeley's Tom Bruns, who organized the meeting, laid out the task before us. With all the new tools of modern technology, we can now bring together large amounts of data and organize it into a meaningful framework. That data — including images, field notes and descriptions, distribution maps, keys, and phylogenetic trees — can then be made widely available on the internet. To accomplish this goal, we will need to identify and train a number of field mycologists to do the work — professional and amateur mycologists in collaboration on a deep level. To ensure taxonomic accuracy, we will have to run DNA sequences on vouchered specimens which, as everybody knows, can be very expensive. Public and private foundation support will be critical to our success.

The contribution of amateurs in this field work will be more than mere crowd sourcing as defined by the newly popular term "citizen scientist." Non-academics will participate in a role exceeding mere gatherers of mushrooms — fully trained to collect, describe and document fungal specimens — relying on their knowledge of local fungi.

This project could identify hundreds if not thousands of species new to science. This effort will also settle the question whether North American and European species now recognized under the same name are indeed the same species or not. For this reason, a mycoflora of North American fungi will be extremely useful to European mycologists as well.

Saturday presentations covered the various pieces of the puzzle: organizing mushrooms in herbaria, creating and coordinating data, establishing a baseline of fungal knowledge, developing training packages and engaging the people needed to begin a project of this scope. The desired outcome includes monographs of macroscopic fungi, phylogenetic trees, pictures, keys — all electronically available.

Nathan Wilson, who created the website Mushroom Observer (MO), told the group how the site could be used as more than a repository of images. MO can be configured to assemble distribution maps, collection data and produce herbarium-ready accession labels. John Pickering, Associate Professor in the Odum School of Ecology at the University of Georgia and creator of discoverlife.org, told the group how his website could be used to create image-rich keys, distribution maps, and incorporate large amounts of data into a field guide format.

Henning Knudsen described how Funga Nordica (Knudsen & Vesterholt), a mycoflora of the Nordic countries, was created: the structure of assembling information such as monographs, the hierarchy of the editing process, the need to adopt a universal non-technical terminology, and some of the barriers the editors encountered. In case you're not familiar with this text, Funga Nordica contains keys and descriptions of 2,675 agarics, boletes, cyphelloids and gastroid fungi.

Next, Barbara Thiers, director of the herbarium at the New York Botanical Garden, reported on the Advancing Digitization of Biological Collections project to digitize the records in major herbaria funded by a grant from the National Science Foundation. The Macrofungi Collections Consortium, with 35 participating institutions, will combine 1.4 million records from herbaria into a searchable database.

In the afternoon, we learned about several "mycoblitz" efforts, including the Great Smoky Mountains ATBI, and how effectively this model can be used to gather lots of data from the field. Ron Petersen listed "Lessons Learned" from his All Taxa Biodiversity Inventory experience: 1) start with a checklist, 2) establish a database, 3) choose your expert carefully, 4) define your scope and depth, 5) an inventory Is NOT a series of monographs, 6) the value of a name (who furnished it and when was it added) is critical, 7), taxonomic synonyms have no place in an inventory, and in conclusion, inventories are not casual sightings! Else Vellinga reported on the survey in Point Reyes National Seashore using a "mycoblitz" model.

Vellinga also gave an example of another approach to sampling that might be called the "hunting license" model, used in the survey of Yosemite National Park. This model involves selecting a smaller set of more highly trained, motivated set of collectors, and giving them instructions and permits. These people can then collect anytime and the examination and initial curation of the specimens is more diffuse. Coordination was facilitated through the web. Each collector was responsible for posting images and basic collection data on Mushroom Observer, as well as posting collection numbers and GPS coordinates on a running list of collections on a Google docs site. Vellinga showed that this approach has worked well in Yosemite and resulted in more than doubling of the specimens known from the park in just the first two years. The biggest problem with this approach is that many areas of the continent lack the critical mass of trained people to execute such a survey.

Mycological societies and academic institutions are also engaged in data gathering, including the long term NAMA Voucher Project, which was presented by Patrick Leacock. With 15 years of vouchered specimens from multiple locations, these collections, housed at the Field Museum in Chicago, provide a baseline of professionally identified fungi. Scott Bates spoke about a new effort underway in the Southwest: the Arizona Mycota Project. Scott Redhead reported on multiple efforts in Canada to document fungi, including the digitalization of 350,000 records at the Canadian National Mycological Herbarium, work to document fungi by the *Cercle des mycologues de Montréal* (the largest amateur mushroom club in

North America), and the Québec Mycoflora Project. Redhead also reminded us that Canada is a huge land mass covering 3,855,103 square miles, while the US is a mere 3,794,083 square miles. The Puget Sound Mycological Society is also in the beginning stages of creating a mycoflora for the Pacific Northwest.

On Sunday, we got down to the business of addressing key structural questions. We broke into four discussion groups, and took our best shot at how to efficiently design the study. Short term goals include determining a platform upon which to build the data; developing a protocol for organization and training; targeting already available monographs which can be put online soon; and identifying fundable units of the program so that the task of grant writing can begin. Bruns estimates that a project of this magnitude could cost between $16 million and $18 million. The desired output will be web based, with free access and editable authored monographs, using standardized terminology accessible to a majority of participants.

One theme evolved in the discussions: the importance of conservation in a rapidly changing world. By conducting a continent-wide survey of fungi, a snapshot of species and distribution will be documented for future generations. We will need to involve other conservation groups in the effort.

My group tackled: how to identify the parts of the continent that are least well known mycologically; how can additional people be recruited and trained; and how can we use a survey effort to enhance training at both the professional and citizen science levels. The group included Bart Buyck, David Lewis, Debbie Viess, Steve Trudell, Christian Schwarz, Cathy Aime, Lawrence Millman, Jennifer Walker, Terry Henkel, and Bill Yule — in my opinion, a fantastic mix of academic and non-professional mycologists.

Our answers to these questions and the outcome of the other Sunday session groups will be incorporated into a white paper, which will be shared on the group website:

http://www.northamericanmycoflora.org/. You can also see more pictures from the meeting and view presentations linked above at the site. The meeting galvanized a lot of support for this project in both the professional and amateur mycological communities. Help us spread the word about this important new project!

More information and an update on the North American Mycoflora project will be presented at this year's NAMA foray in Scotts Valley. As the project develops, you will be hearing more in *The Mycophile*. Stay tuned…

David Arora and Scott Redhead

Matt Smith, Else Vellinga and Gary Lincoff

To see the set of 16 videos taken at the workshop in New Haven:
http://www.youtube.com/playlist?list=PLOyuQaVrp4qrweAIKZRhJjlPFj2gbYJgY&feature=view_all

2012 FORAYS AND ANNOUNCEMENTS

Sept. 20 - 23: NAMA WILDACRES REGIONAL FORAY Price is $225 per person. Contact registrar Glenda O'Neil at glendakoneal@yahoo.com or at 423-246-1882 and see website www.namyco.org/events/index.html.

Sept. 22: The GARY LINCOFF MID-ATLANTIC MUSHROOM FORAY. The headquarters for this popular one-day foray will be at Rose Barn in Allegheny County's North Park, just north of Pittsburgh, PA. We are again fortunate to have Gary Lincoff as our principal mycologist. The other mycologists include Rod Tulloss and Bill Russell. Rod Tulloss is a world expert on the genus Amanita. Bill Russell has a wealth of knowledge about mushrooms of Pennsylvania. Our own John Plischke III has agreed to lead the invited mycologists and club mycologists/identifiers in classifying all the mushrooms we find on the guided walks. There will be guided morning walks and afternoon speakers & cooking demonstration. The club's mushroom feast in the late afternoon is always a highlight of the foray. Last year, 16 club members prepared 31 amazing mushroom dishes for the feast. More details can be found on the website. http://wpamushroomclub.org

Sept. 28-30: Foray Newfoundland and Labrador in beautiful Terra Nova National Park. Information and registration forms are on their website www.nlmushrooms.ca.

October 21 - November 4: Foray to Ambruzzo-Molise region of Italy.

November 3-18 Foray to the island of Sardinia. In addition to these two forays to Italy, we discover and sample the cultural offerings and the cuisine of the regions. For information contact Albert Casiero at casciero@wrlc.org

Dec. 13-16: NAMA 52nd ANNUAL FORAY at Mission Springs in Scott's Valley, California. Guest mycologists include Chief Mycologist Dr. Else C. Vellinga, David Arora and others.

HOW I BECAME INTERESTED IN COLLECTING FUNGI

(Stories from NAMA Members)

1 *Alan McClelland*

As far back as I can remember, my brother taught me to appreciate the forest and every little wonder within it. Much like he taught me to appreciate reptiles and amphibians, he also sparked my interest into the mysterious world of fungi during my teenage years. He would take me along every year in late April to go morel picking with my cousins who lived in Ashland. We would go to our cousin's best scouted areas for hours to find these elusive treasures. If we were lucky enough to find many, we usually followed this up in the evening with a tasty meal of delicious mushrooms! This spring tradition carried on for years to come.

During my college years in the early 90's, my brother started to scout areas closer to home in Akron, so our bounties became even more plentiful and diverse. My brother being a chef for most of his life, had prepared several delightful meals over the years of a variety of morels for us to enjoy during the springtime season.

During this time, unfortunately, I experienced a severe poisoning leading back to these delicious little gems. Even though, I did not believe it myself and had eaten these most of my life, I ended up in the intensive care unit of the hospital for a few days I will never forget. Although I experienced this poisoning, that almost destroyed my liver, a few years later I unsuccessfully attempted to eat two very well-cooked *deliciosa* morels. I found myself in anaphylactic shock within twenty minutes after eating them and another few days in the hospital. From then on, I accepted the truth that my body chemistry had changed over time and I had developed a very rare allergy to this particular species of mushroom. I blame no one but myself to this day, but it's tough to part with something as tasty as morels! Thankfully, I can eat most other species of mushrooms with caution. Despite being poisoned those two times, I continued to pick morels every spring with my brother and even acquired a better eye at finding them. Still, I envied the rest of my family, who could eat morels with no ill effects. My brother passed away in 2007, after a seven-year struggle with a rare bone marrow cancer known as multiple myeloma in 2007.

This leads me to now, and how much more I appreciate and respect the mesmerizing world of fungi and not just species of morels. In the summer of 2010, I finally decided to join the Ohio Mushroom Society and actually learn more about the actual diversity of mushrooms species we have in Ohio. Being a member has lead me into not only starting to recognize the diversity of fungi species we have throughout the world, but the role of importance they hold that we are now only discovering in the past decades! It is said that there are well over 2000 different species of fungi alone in Ohio. Which to me sounds quite outlandish as most of us have only seen a small number of those species, if any at all in the wild or urban areas. This is not very uncommon amongst our Western upbringings as opposed to Eastern societies and how their knowledge of fungi has far surpassed ours for centuries. We are only now starting to understand what they have carried on from generation to generation. Leading mycologist Paul Stamets' groundbreaking research and publications alone are fascinating and he is revolutionizing the importance of these elusive charms of the forest! Myco-remediation may just save this planet some day. And understanding the importance of fungi in medicine may just save our lives!

Knowing this makes me eager not only to learn more about the importance of fungi, but to experience these individual species in their natural environment. To be there when these wonderful and mysterious things are growing in their natural state is a personal charm. To capture these moments with my camera lens is the reward and the education undeniable. In the next few months, I am revealing an Ohio Fungi series that I started in early 2011 and will be an ongoing collection much like my Delicate Balance nature series I have executed over the years. Because the diversity of species is immense, I will be presenting this series in seasonal installments throughout this year for those to enjoy.
This work is dedicated to Paul McClelland (February 20,1962–February 5, 2007)

2 *Esther Bates*

My late husband, Marty Bates, grew up in China, and I grew up in Germany. Both of us spent the summer of 1946, just prior to our marriage, as camp counselors in northwestern Maryland. The boys' camp and girls' camp were ten miles apart, but my husband-to-be managed to come to visit me on his days off. The area was delightfully wooded, and we enjoyed strolling through those woods together. On our walks, we saw quite a number of mushrooms, but realized that we had no idea what they were, despite childhood memories of picking mushrooms for our parents' tables in China and Germany.

The next summer, we were counselors at a Fresh Air Fund camp near Brewster, Connecticut. It was a rather wet summer, and on our daily walks to the swimming area along a newly constructed path, we saw a bewildering variety of mushrooms in the freshly dug banks. On our first day off, we went to a bookstore in Brewster and bought a copy of Krieger's mushroom guide. From then on, we were hooked. Mushroom hunting became our favorite weekend leisure activity; we gradually acquired a large library of mushroom identification books, attended numerous forays, found mushrooms in backyards, state and county parks, and learned to identify many species.

We enjoyed eating our "catch" when that was feasible, and our passion has been passed on to two of our children. In fact, I could not resist enclosing a photo of the magnificent morels our daughter picked in Vermont a few years ago. When she came to visit me recently, she brought along a container of frozen morels, which we enjoyed with eggs for a delicious breakfast.

Becki Bates

3 *Elizabeth Pataki*

It all began years ago in the 1940's with my father, Janos Pataki. He was a Hungarian immigrant who came to the U.S. as a three-year-old child and didn't learn to speak English well until he was in the 6th grade and a kindly teacher and a dictionary welding librarian took him under their wings and suddenly opened the world to him.

He was an Electrical Engineer in the Merchant Marines and also a knowledgeable farmer, home gardener, beekeeper, maple sugar maker, and a dedicated amateur mycologist. On the weekends, equipped with a wicker basket and penknife, he would take us three sisters out to the meadows and woods nearby to hunt on "fairy paths" for mushrooms which would appear overnight as if by magic.

He taught us how to identify mushrooms by season, location, growth habits, age, how to correctly harvest and spore them, and to appreciate their earthy aromas. It was only later in life, having eaten them for many years, when we found out that after carefully identifying new mushrooms by morphology and spore print, he would feed them to the dog, wait a day, eat them himself, and then finally serve them to the family.

After he passed away at age 81 (not from bad mushrooms), I inherited his beloved "Mushroom Hunters Field Guide" and now I pass this tradition on to my children. By the way, the dog, a lovely beagle, lived to a ripe old age.

We invite you to send in <u>your</u> story about how you became interested in fungi to diannasmith@optonline.net

Every mycophile is aware of a very strong association between slugs and mushrooms. More observant mushroomers may also note that slugs favour some mushroom species while shunning others. However, such preferences and their mechanism remain poorly understood by malacologist and mycologist alike. In 2010 Maunder and Voitk published a preliminary review of the relationship in Newfoundland and Labrador, with an overview of available literature on the subject.[1] Their study documented slug-mushroom associations retrospectively, primarily based upon their existing personal photo collections. The profile of slugs recorded corresponded to that expected for the regions surveyed. However, the profile of mushrooms where slugs tarried deviated significantly from the regional mycotal pattern. Maunder and Voitk concluded that slugs showed significant preference for some mushroom species over others, and that this preference was unrelated to the prevalence and distribution of the latter in the habitat.

Because it was retrospective, the 2010 study was uncontrolled and almost certainly subject to whatever non-random variables that led the authors to photograph their subjects. The present study attempts to eliminate most such variables by prospectively noting all slug and mushroom associations during the course of a regional all-taxa mushroom census.

Methods

The study was carried out during the Annual Foray of Foray Newfoundland & Labrador (FNL), September 11-13, 2009, in Central Newfoundland. FNL foray procedure is for small groups of participants to collect as many macrofungal species as possible along designated trails. The mushrooms are then identified by invited mycologists, and photographed, and voucher collections are deposited in the FNL fungarium. A species list, with the number of collections used as a primitive estimated of abundance, is developed. A Report, with this list and other data for the 2009 foray, is available on the FNL website <http://www.nlmushrooms.ca>.

The study was conducted along four of the trails surveyed—two trails in and around the Max Simms Camp grounds and environs (south of Bishop's Falls), Notre Dame Provincial Park (between Grand Falls-Windsor and Gander), and Thomas Howe Demonstration Model Forest (near Gander)—on September 12, 2009. One person was assigned to each trail as a designated slug collector. Because slugs are far less common in trees and other aboveground environments, the study was limited to terrestrial mushrooms. All terrestrial mushrooms collected along the designated trails on September 12, 2009, formed the mushroom control population. All slugs encountered on terrestrial mushrooms were collected live in a container, and labeled to link to their respective mushroom collection. Slugs

were photographed, sacrificed in water, preserved in alcohol and placed with the Natural History Unit of the provincial museum (NFM). The specimens were identified by John Maunder at a later date.

Results

The control mushroom population was made up of 455 collections, accounting for 155 species; the number of collections of each species varied from 1-18 (Figure 1). Pedestrian (uncommonly abundant) mushroom species were defined as species with collections in excess of 2 standard deviations above the mean number of collections for all the species. There were nine such species (Table 1). Detailed species list available on request. A total of 63 slugs were collected for a "slug rate" of 13% (63 slugs on 455 mushroom collections). Owing to labeling problems, the data linking 34 slugs to their associated mushroom collection were incomplete, leaving study groups of 29 slug collections and 27 mushroom collections, where individual slug species could be directly connected to their associated individual mushroom species (Table 2). Species richness and abundance of the 29-slug study group were similar to the group representing all 63 collected slugs (Figure 2), suggesting that the study group is a valid sample of the mushroom associated slug population. The 29 slug collections represented five species from two genera. The 27 mushroom collections represented fourteen species from eight genera (Table 3).

Table 1. **Pedestrian* (the "commonest") mushrooms in study area**
Number of collections of each in brackets.
Bold print face indicates species on which slugs were found.
Cortinarius collinitus (18)
Cortinarius caperatus (16)
Cortinarius flexipes (14)
Lactarius deceptivus (14)
Leccinum scabrum (12)
Paxillus involutus (11)
Cortinarius semisanguineus (10)
Laccaria laccata (10)
Leccinum holopus (10)
*2 standard deviations above the mean

Table 2. **Slug-mushroom association**

Amanita fulva	*Arion fasciatus var. silvaticus*
Amanita muscaria	*Arion subfuscus*
Boletus huronensis	*Deroceras laeve*
Cortinarius anomalus	*Arion subfuscus*
Cortinarius caperatus	*Arion subfuscus*
Cortinarius caperatus	*Arion distinctus*
Cortinarius caperatus	*Arion subfuscus*
Cortinarius caperatus	*Deroceras reticulatum*
Cortinarius solis-occasus	*Arion distinctus*
Lactarius deceptivus	*Arion sp.*
Leccinum scabrum	*Arion subfuscus*
Leccinum scabrum	*Arion subfuscus*
Paxillus involutus	*Arion subfuscus*
Russula adusta	*Arion subfuscus*
Russula brevipes	*Deroceras reticulatum* (x 3)
Russula paludosa	*Arion subfuscus*
Suillus granulatus	*Deroceras laeve*
Suillus granulatus	*Arion cf. distinctus*
Suillus clintonianus	*Deroceras reticulatum*
Suillus clintonianus	*Arion subfuscus*
Suillus clintonianus	*Arion subfuscus*
Suillus clintonianus	*Deroceras laeve*
Suillus clintonianus	*Arion subfuscus*
Suillus clintonianus	*Arion subfuscus*
Suillus clintonianus	*Arion subfuscus*
Suillus clintonianus	*Arion subfuscus*
Suillus clintonianus	*Arion subfuscus*

Although slugs were commoner on the commoner mushroom species, the profile for slug preferences did not match mushroom abundance (Figure 1). Five of the nine pedestrian mushroom species (Table 1) were slugless, while some relatively uncommon mushrooms (Table 3) had several slugs. The species most favoured by slugs was the *Suillus clintonianus/ grevillei* complex, which yielded 9 slugs from 5 collections. Boletes were the group most favoured by slugs: 53 bolete collections yielded 14 slugs (26%). *Russula* species were also popular, with 3

Table 3. **Mushroom species with slugs in order of slug frequency**
Number of slug collections in brackets
Bold print face indicates pedestrian mushroom species.

Suillus clintonianus (9)
Cortinarius caperatus (4)
Leccinum scabrum (2)
Suillus granulatus (2)
Amanita fulva (1)
Amanita muscaria (1)
Boletus huronensis (1)
Cortinarius anomalus (1)
Cortinarius solis-occasus (1)
Lactarius deceptivus (1)
Paxillus involutus (1)
Russula adusta (1)
Russula brevipes (1)
Russula paludosa

slugs from 13 collections (23%). In comparison, only 4% of the 146 collections of the genus *Cortinarius* yielded slugs, and most of this total was due to slug fondness for *Cortinarius caperatus*: four of the six *Cortinarius*-associated slugs came from this species.

Discussion

The "slug rate" seems low, compared to our notion of the frequency of the slug-mushroom association. Perhaps the rate is higher in our minds because of the emotional overtones it acquires when collecting edibles—damage done to even one bit of our intended meal by our rival mycophagists seems so personal! The rate is also influenced by the units used; had we used individual sporocarps instead of collections, the rate would have been even lower. In addition, the rate is likely influenced by habitat, season, dampness, time of day, abundance of other slug food, and many other factors. Our results are limited to identifying actual slugs at the moment of collection, which in no way excludes slug visits to other mushrooms at other times.

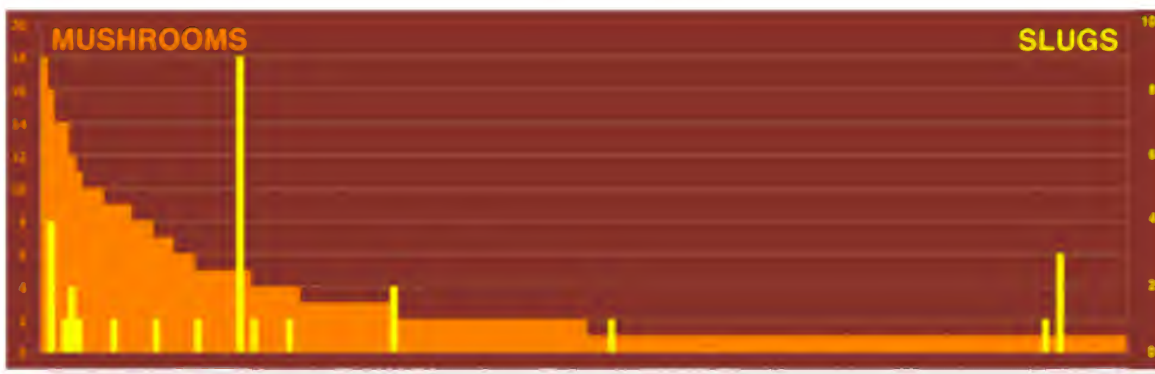

Figure 1. Distribution of mushrooms and slugs. Tan columns represent the mushrooms species of the control population, arranged in decreasing order of number of collections (scale on left). Yellow columns indicate the number of mushroom-associated slugs overlying their respective host species (scale on the right). Although, as one might expect, more slugs were collected from the more abundant mushroom species, clearly the slug preference for mushrooms does not mirror mushroom abundance alone. Some quite wide discrepancies are noted, with some very common species with no slugs and some uncommon species with a moderate to high amount of slugs.

If slugs visited mushrooms indiscriminately, they should be distributed among mushroom species in proportion to the commonness of the species in an area. While more slugs were indeed found on the more common mushroom species, within this general trend it was quite evident that slugs did not visit mushroom species in proportion to the latter's relative abundance. Five of the nine commonest mushroom species, had no slugs on them at all. The three most common mushrooms in the control mycota were species of *Cortinarius*: 32 collections of *C. collinitus* and *C. flexipes* combined had no slugs, as opposed to 16 collections of *C. caperatus*, with a 25% slug rate. The largest genus, *Cortinarius*, had a 4% slug rate on 146 collections. Boletes made up the most popular group, with a

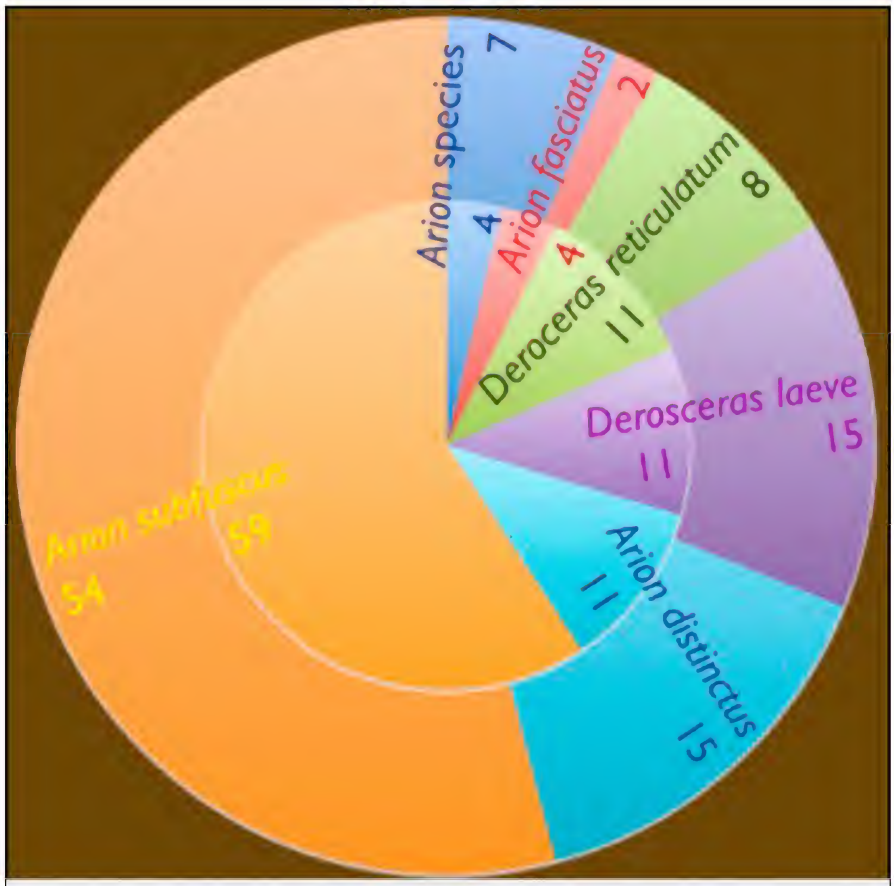

Figure 2. Slug abundance ratios. The inner circle represents the study group. Numbers indicate the per cent occupied by each species. Arion subfuscus is by far the commonest. The others seem to be evenly distributed between meadow dwellers and forest dwellers. The outer circle shows the same distribution for all 63 collected slugs. The similarity of the distributions suggests that although some mushroom-associated slugs were lost to the analysis, the study group is a valid sample of the mushroom-associated slug population.

26% slug rate in 53 collections, twice the overall slug rate. Among these, the *Suillus clintonianus/grevillei* complex yielded 9 slugs from 5 collections. Intuitively, these findings may not be overly surprising. If offered a wide range of foods, all of us would end up preferring a relatively small selection of the available spectrum. Some of the mushrooms we study show a very rigid and unyielding preference for specific hosts. No matter how many trees are available, some will grow on alder only, and some of these only on one of our two alder species. Why should we expect slugs to be different from mushrooms and us? On the other hand, while our findings may seem obvious intuitively, to date such intuition has not been translated into scientific information. To our knowledge, this represents the first prospective study, simultaneously using a matched control mycota, to confirm that in their natural habitat slugs do, indeed, prefer some mushrooms over others, and may even avoid some, no matter how prevalent. This opens the door for speculation about reasons for this behaviour, formulating theories that can be tested by further enquiry. A potential explanation is that this behaviour is tied to different sporulation strategies evolved by different mushroom species. During centuries of coevolution, perhaps mushrooms and slugs have worked out some kind of mutually accommodating relationship that guides their interaction. For example, perhaps some mushrooms and slugs have coevolved, so that slugs play a role in spore distribution. Those mushrooms may have evolved to produce some form of slug attractant, explaining, as an example, why we found slugs on 23% of *Russula* species. The relationship need not be obvious or direct. For example, the said *Russula* species seem to be a favourite of mycophagous *Drosophila* flies, who may be the vectors. Slug eaten mushrooms produce more than twice as many flies as similar slug-free mushrooms.[2] Thus, slugs may play an enhancing role in a very complicated chain that joins several species for mutual benefit.

Perhaps other mushroom species have evolved to employ different spore dispersal mechanisms, to which slugs might pose a threat. Have some of these mushroom species evolved repellant mechanisms such as antifeedants to keep slugs away? Is this the evolutionary path chosen by the ubiquitous and common *Laccaria* species, explaining why no slugs were found on 13 collections?

Conclusions

Despite their omnivorous reputation, slugs show marked preferences and avoidance patterns to mushrooms selected for mycophagy. The reasons are not known, but the results encourage speculation about the role of selective coevolution to promote spore distribution or prevent spore destruction. These results encourage investigation of possible attractants and antifeedants to mediate these relationships.

Acknowledgments

The authors thank all the participants of Foray Newfoundland & Labrador's 2009 Annual Foray, and particularly members of the Database Team, who doubled as slug collectors for this study, and helped with the recording, photography and processing of collected specimens.

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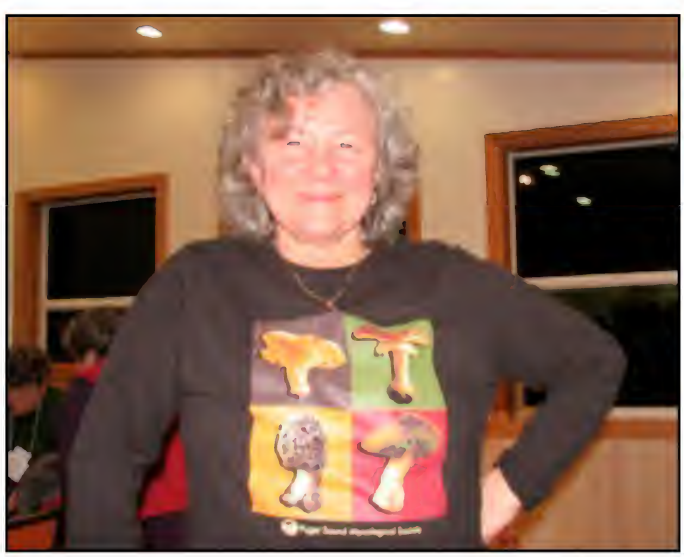
*This article first appeared in **Omphalina**, Newsletter of Foray Newfoundland and Labrador, Vol.III, No. 6, June 21, 2012.*

PATRICE GALES BENSON 1953–2012



It is with profound regret that we report the death of Patrice Benson on July 25, 2012, from stage 4 cancer diagnosed in June.

A mainstay of PSMS since she joined at the annual exhibit in 1976, Patrice had an unrelenting interest in fungi hunting, identification, and culinary enjoyment. Over the years, she served in almost every position possible in the society—class instructor, mycophagy chair, publicity chair, education chair, trustee, vice president, and president (twice). She was a mushroom missionary extraordinaire, spreading the mushroom gospel to the outside world through classes, lectures, slide shows, and hands-on projects geared to both adults and children. She was PSMS representative to the North American

Mushroom Association.

In addition to her promotion of PSMS, she founded and directed the annual mushroom gathering at Breitenbush Hot Springs, an event that draws mushroom lovers from around the nation and world. She was also the president of the Daniel Stuntz Foundation, which supports mycological research at the University of Washington.

Although most of you will remember Patrice for her enthusiasm about mushrooms and cooking, she was also devoted to several non-mushroom activities.

Of Polish descent, she was an active participant in the city's Polish-American community. A career hematologist, in 2005 she founded BenTech Biotechnology Services, a major provider of human blood cells for medical research. She was the 26th member of the Seattle chapter of *Les Dames D'Escoffier*, a national organization of chefs, restaurateurs, and other promoters of fine food. She was an expert gardener, Girl Scout leader, and dependable volunteer for many jobs in support of her family and community.

Patrice is survived by her husband, Dr. Edward Benson, and daughters Katie and Jill, all of Seattle. Our condolences to all of you.

To Patrice—that's she's in some kitchen or flower garden somewhere special, sharing her smile, her food, and her love with yet one more group of friends who adore her.

Denny Bowman of the Puget Sound Mycological Society

NAMA would like to acknowledge the generous gift of $1000 donated to our organization in loving memory of lifetime member Jirina Polivka by her family of 228 San Remo Avenue, North Port, Florida 34287.

Marketing Committee Surveys Members

The NAMA Marketing Committee conducted a series of surveys in July. We asked a variety of questions to gauge members' interest, knowledge, and use of NAMA programs, publications, website, newsletters and forays. We will study and compile your responses to make recommendations to the Executive Committee and trustees.

The surveys were broadcast to several different NAMA constituencies: affiliated club trustees and club officers, NAMA officers, members, life members, and past members. A total of 232 people responded, which represents a significant sample. Thank you to everyone who took the time to complete our survey.

We asked several questions about involvement in local club activities to get a better picture of who our members are and their level of involvement with mushrooms and the mycological community. Some of the answers were expected; some were surprising.

Here's a sampling of survey results:

About 60% said they do not regularly attend their local club meetings or participate as officers. However, 66% said that they have attended an overnight mushroom foray more than 50 miles from home; 66% have also attended a large foray with more than 100 people. When asked about their primary interests in mycology, 66% identified an interest in taxonomy, 73% said they were interested in mycophagy and 63% chose photography (multiple choices add up to over 100%). An overwhelming number of respondents said their local club has a newsletter, only about half said their club puts on an annual fair for the public.

Of the total responses, 87% said they take pictures of mushrooms, 50% have considered entering NAMA's photography contest, and 62% own and use a microscope. Obviously, the respondents are more deeply involved than your average mushroomer.

People like NAMA's publications, but they want them on time and full of interesting original content. The trend to electronic delivery and online availability of publications is not popular with long-term members. Many excellent suggestions regarding future content were expressed.

As expected, travel distance and cost were listed in the decision whether to attend NAMA annual forays. While there were a few people who said they had been to 10-30 annual forays, most respondents have attended between one and five annual forays. Most members prefer local or regional forays, where edibles and identification of local fungi is stressed.

Finally, the Marketing Committee offers a very special thank you to Becky and John Plischke for all their remarkable work to input and tabulate these surveys, as well as their donation to cover the cost. *David Rust*

!NAMA LOOKING FOR PROGRAMS LOAN LIBRARIAN!

Our NAMA Programs for Loan Librarian, Carlene Skeffington, is moving to New Mexico and is taking the programs with her. The programs may be requested at her new location after Aug. 01. Here is her new information:

Address:
Carlene Skeffington
P.O. Box 46
Sunspot, NM 88349-0046
Home phone: 575-434-8703
Cell phone: 603-831-8484

E-mail: carleneskeff@gmail.com

If any NAMA member is willing to replace Carlene as Programs Librarian, please write to Carlene with your offer. Carlene has been doing this job for many years. Requests for programs have decreased due to the new CD programs that can now be copied by the borrower.

Mycodigest:
Let It Rot (Or Not)

The wooden gate beside our house is slowly disintegrating into square bits and pieces. It's definitely a sign of fungi at work, though they are invisible, and do their job without making fruitbodies. The kind of rot the fungi in my gate produce is called brown-rot, in which the lignin in the wood is left behind in brown chunks, and the cellulose is attacked by the fungus' enzymes and broken down for food. A walk in the California woods will give you lots of examples of brown-rot, as brown-rot fungi love conifer trees. The red-belted conk, *Fomitopsis pinicola*, is a good example of a very common brown-rotter; *Serpula* the dry-rot fungus is another well-known, and feared, example.

There is a second type of common rot, white-rot, so called because of the white cellulose that is left behind, after the fungi have attacked the lignin. The material left behind is white and stringy and can be torn as if it were a cooked chicken breast. Degrading lignin is a difficult job, and a specific set of enzymes is needed for it. Nevertheless, there are many different white-rot fungi, *Pluteus* and the turkey tail *Trametes versicolor* are just two of many examples.
Brown-rot fungi differ from white-rot fungi in their toolkit – they have a different set of tools (enzymes) to break down the wood components. Not only are the enzymes different, but also the genes regulating the enzyme production. That is the area of research that has received much attention lately. It is easier nowadays to look at the genes than at the various enzymes!

The few examples I just mentioned belong to very different systematic groups: *Fomitopsis* and *Trametes* are polypores, but *Pluteus* is a gilled mushroom, and *Serpula* is a relative of the boletes. Species are assigned to a certain genus based on the kind of rot they produce. The brown-rotting *Neolentinus* species, such as *N. ponderosus* of the Sierra Nevada, were removed from the genus *Lentinus* and put in their own genus, leaving the white-rot causing *Lentinus* species behind. The phylogenetic tree of the basidiomycetes shows a mosaic of brown-rot and white-rot fungi. At the base of the tree are brown-rotters such as *Dacrymyces*, followed later by the *Agaricomycetes* which are thought to be the first white-rot fungi. The rise of the white-rot, lignin and wood decomposing fungi coincides with the end of the big coal deposits. Coal is of course a form of fossil wood, and wood comes from trees. Could it be, that with the explosion of white-rotters, all the dead trees were decomposed leaving no wood behind to form coal?
After that first flurry of white-rotting species, brown-rotters evolved again and again.

The fungal phylogenetic tree also harbours species that are not decomposing wood to satisfy their energy needs: parasitic fungi living off live trees are scattered throughout and so are mutualistic ectomycorrhizal fungi – those that get their carbon directly from the tree in exchange for nitrogen and other nutrients. The latter also occur on various branches of the phylogenetic tree: chanterelles, boletes, coccoras and shrimp russulas to name a few. They often are close relatives to saprotrophic species and again often placed in their own genus – *Paxillus involutus* is ectomycorrhizal, but *P. atrotomentosus* is now placed in the genus *Tapinella* as it is a wood-rotter. There is always the question how these different modes came about, did the wood-decayers gain the enzymes to tackle the various components of wood, or did the ectomycorrhizal species lose the ability to degrade plant material?

The set of questions raised above was tackled in a neat research project for the genus *Amanita*. A small number of *Amanita* species is found in grasslands or in forests without ectomycorrhizal tree hosts; these species are decomposers. The majority of *Amanita* species, however, lives in a mutualistic relationship with trees. The saprotrophic *Amanita* species form a small group at the base of the *Amanita* phylogenetic tree, with the rest of the species forming a single-stemmed huge branching tree with many many species. In other words, a single event caused the change from saprotrophism to ectomycorrhizal nutrition, and this was followed by the rise of many different ectomycorrhizal species. They took off and formed many species as soon as they discovered that living trees, rather than dead trees, are a really good source for carbs.

So what was this single event that caused the fungi to switch from eating dead trees to living happily with live ones? The switch, as it turned out, was the loss of two important genes active in cellulose degradation: none of the ectomycorrhizal *Amanita* species has these two genes, but the genes are in the DNA of the saprotrophic species. Of course now we know the differences, we can investigate what came first, the discovery of living tree roots as a source of food, or the loss of enzymes and the forced change in nutritional mode (or lifestyle if you like).

Other fungal groups might show a different approach, with the loss of different enzymes, or the gain of others. Nature is inventive, and the same path is not necessarily taken twice. Time will show, and in the meantime, our garden gate is slowly but surely consumed, by fungi.

Further reading:

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Skrede I, Engh IB, Binder M, Carlsen T, Kauserud H, Bendiksby M, 2011. Evolutionary history of *Serpulaceae* (Basidiomycota): molecular phylogeny, historical biogeography and evidence for a single transition of nutritional mode. BMC Evolutionary Biology 11: 230 [open access]

Wolfe BE, Tulloss RE, Pringle A, 2012. The irreversible loss of a decomposition pathway marks the single origin of an ectomycorrhizal symbiosis. PLOS one 7 (7) e39597 [open access]

Else Vellinga, Ph.D., is interested in mushroom taxonomy and has been studying mushrooms in California and beyond for years. A frequent contributor to Mycena News, she is also fascinated by interactions between fungi and other organisms. In her free time she knits, and knits, and knits!

*This article first appeared in the September issue of **Mycena News**, the newsletter of the Mycological Society of San Francisco.*

CORRECTION: In my July-August review of Gljive Srbije i Zapadnog Balkana (Fungi of Serbia and the Western Balkans), I mistakenly attributed most of the photographs to the author, Branislav Uzelac. In fact, about 95% of the book's photos were taken by Goran Milosevic. I apologize for the error.
Steve Trudell

An Evolutionary Tale of Zombie Ants and Fungal Villains & Knights

by Gemma Reguera

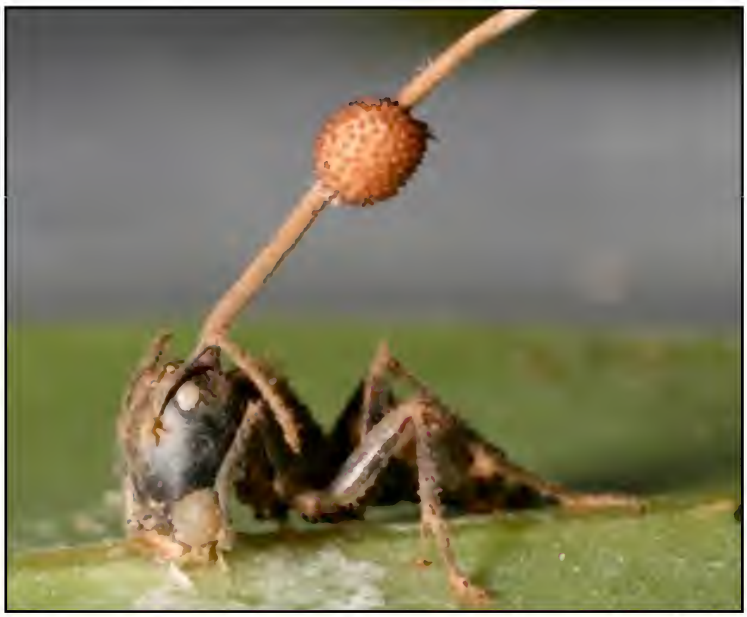

Fig. 1: An ant infected by *O. unilateralis* bites the underside of a leaf. The fungal stroma emerges from the back of the ant's head and develops a fruiting body with a capsule full of spores. Once matured, the capsule is released and the

In a recent post I shared with you some amazing things I had learnt about coprophilous ('*dung-loving*') fungi that spit their spores like pros. What I did not tell you then is that my six-year-old son also fell in love with the spitting fungi (dung + spit = child's interest!) and wanted to learn more. So we spent hours watching online videos until we stumbled upon a BBC's *Planet Earth* video narrated by the great David Attenborough about ant parasitic fungi in the genus *Cordyceps*. The video shows a carpenter ant (genus *Camponotus*) that has been infected by spores of the fungus *Ophiocordyceps unilateralis*. The spores germinate inside the ant's respiratory track and the mycelia grow towards the brain while feeding on soft tissues. Once the fungus reaches the brain, it induces behavioral changes such that the ant climbs up vegetation and bites the underside of the leaves. There the ant awaits its death while the fungus continues to grow within. The stroma stalk of the fungus eventually protrudes from the back of the ant's head and a fruiting body bearing a capsule filled with spores forms near its tip (Fig. 1). Once the spores are sexually mature, the capsule is released, and then explodes, either in the air or upon hitting the ground. This delivers the spores into the path of healthy ants, there to start a new cycle of infection.

Right away, I searched the fungus name in the STC blog and found a beautiful post by Ilham Naili that describes the life cycle of this parasitic fungus in more detail. I also started my own search and learned that the fungal spores can attach to the ant's body and secrete enzymes to penetrate through the cuticle. These are indeed some aggressive parasites capable of a generalized body invasion. In fact, some pictures of dead ants show the fruiting body protruding through their abdomen, rather than the back of the head. But spores also enter the ant though its respiratory spiracles (aka the exoskeleton openings that allow the air to enter the trachea). This appears to be the most efficient route because the spore can use the nutrients provided by non-essential soft tissues within the respiratory track to grow its mycelia in close proximity to the ant's brain. There, bioactive compounds secreted by the mycelia enter the ant's brain and effectively block pheromone reception. This disorients the ant and leaves it under complete fungal control. Like a zombie, the ant climbs up the trees and bites a vein on the underside of a leave with great force. Interestingly, the shape of the grip bite mark is very distinctive and is similar to marks identified in 48 million year old fossil leaves!!!!! This biting behavior effectively immobilizes the dying ant upside down under a leaf, but also lowers its head (Fig. 1). It appears as if, in doing so, the ant submissively bows to its destiny and exposes the soft tissue between the head and the trunk to facilitate the protrusion of the fungal stroma stalk.

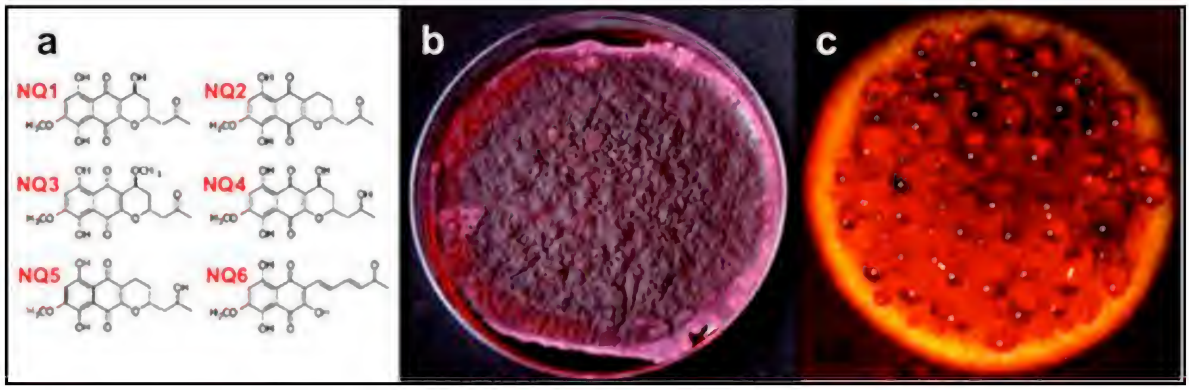

Fig. 2: *O. unilateralis* growing on potato dextrose agar for 7 days secretes six type of naphthoquinones. The formulas are shown in (a) and the growth of the fungus on the agar in (b). After 12 days of incubation the naphthoquinone secretion is so copious that it forms droplets on the plate (c). Source.

Concerned as I was about prematurely destroying my son's love for microbes, I set out to learn more about Cordyceps, avidly searching for that 'positive something' about them that could alleviate the bad memory of the brain-eating fungus. Cordyceps, I learned, is a fungal group (in addition to a genus) in the Ascomycota that comprises hundreds of species. All are endoparasitic; most parasitize arthropods, though a few infect other fungi. Amazingly, each fungus specializes in infecting a single type of host. While some can infect other hosts, reproductive success is often compromised. Not all affect the host's behavior, but those that do are known to produce copious amounts of bioactive compounds. *O. unilateralis*, for example, secretes at least six types of secondary metabolites broadly known as naphthoquinones (Fig. 2). All six have antibacterial, anticancer, and antimalarial activity. Well, there goes something positive ...

The question that lingered in my mind was what mechanism, if any, could protect the ants from the deadly fungus. The ants build their nests in the above-ground vegetation. But the parasitic fungus controls the behavior of the infected ants and forces them to climb upwards so they die close to the colony's nest. This maximizes the chances of infecting healthy individuals. Furthermore, dead ants are often found at high densities (approximately 26 per m^2) in localized areas of the vegetation termed graveyards. This helps concentrate the released fungal spores in the ants' path on the forest floor beneath. Healthy ants are known to actively avoid the zombie ant graveyards and only venture to the forest floor occasionally—strategies that prevent infection. This spatially limits their resources but, *hey,* giving up some food sources seems like a good evolutionary trade off to ensure the survival of the colony.

Just when I thought this was it for the defenseless ants, I stumbled upon a paper by David P. Hughes's group published in *PLoS One* about a white fungus that comes to the ant's rescue. Who is this mysterious knight? None other than a cousin of the Cordyceps! The fungal family *Clavicipitaceae* includes genera with sexual cycles such as the *Cordyceps* as well as asexual genera such as the *Polycephalomyces*. Cordyceps are often parasitized by *Polycephalomyces* spp. This makes the Polycephalomyces white knight a hyperparasite (aka a parasite of a parasite). Cordyceps are especially susceptible to infection during the stroma stage. Once the hyperparasite infects a stroma, it feeds from it and prevents the formation of its fruiting body (Fig. 3). More than half of the dead ants in the graveyards surveyed by the researchers were hyperparasitized. The brain-eating fungus has a slow maturation process, needing approximately 4 weeks to form the stroma and 4 more weeks to produce sexually mature fruiting bodies. This allows sufficient time for the white fungi to infect the Cordyceps stroma. As a result, the white fungi prevent the formation of a sexually mature fruiting body and 'castrate' the brain-eating fungus on the spot.

The lengthy maturation process of the brain-eating fungus also exposes the fungal structures to environmental insults for prolonged periods of time. In fact, as many as 13% of the fungal structures in the dead ants surveyed in the study were damaged. Furthermore, in 25% of the dead ants, the fungus had not completed the maturation of their fruiting bodies,

possibly because of inadequate temperature and humidity. The combined action of the white fungus and environmental insults rendered most (93-94%) of the dead ants sterile and posing no risk of infection. To make things worse for the Cordyceps fungus, more than half of the remaining infective fruiting bodies suffered from some sort of 'sexual dysfunction' and could not shoot their spores when tested under laboratory conditions. Yet, once matured, the fruiting bodies were robust; they were immune to the white fungi and able to survive in the environment for prolonged periods of time. This capability for long-term survival compensates, at least partially, for the low dispersal potential and increases the reproductive success of the parasitic fungus.

In the end, the white knight, with a little help from the environment, ensures that only a few, but very robust, fruiting bodies are produced over time. This is enough to increase the size of the ant graveyards slowly, but steadily, so sexually mature spores can be produced at regular intervals for longer periods of time. The researchers compared this evolutionary trade-off to a phenomenon called iteroparity, a reproductive strategy in which an organism produces offspring in successive cycles, rather than in a single event, to ensure long-term survival. Every zombie ant that joins the graveyard is like a new 'pregnancy' for the fungal villain but also food and shelter for the white knight. This along with the ants' preventive measures to avoid contact with infected individuals and areas of high spore concentration ensures a perfect balance between the survival of the ant colony and the parasitic and hyperparasitic fungi, so none goes extinct. And although the video of the brain-eating fungus should be rated PG-13 for the animal-loving audience, I can't help but admire how beautifully nature intertwines the lives of animals and microbes to keep a harmonious balance. This is indeed a true tale of co-evolution, with zombies, villains, and white knights included. I just need to wait a few more years until I can help my son understand that this is, indeed, a story with a happy ending.

Fig. 3: A stroma of *Ophiocordyceps nutans* infected by *Polycephalomyces* sp. is shown on the left. As a comparison, a healthy, non-parasitized stroma with its red fruiting body is shown on the right.
Credit Alisha Owensby. *Source*.

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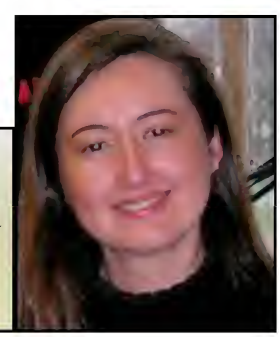
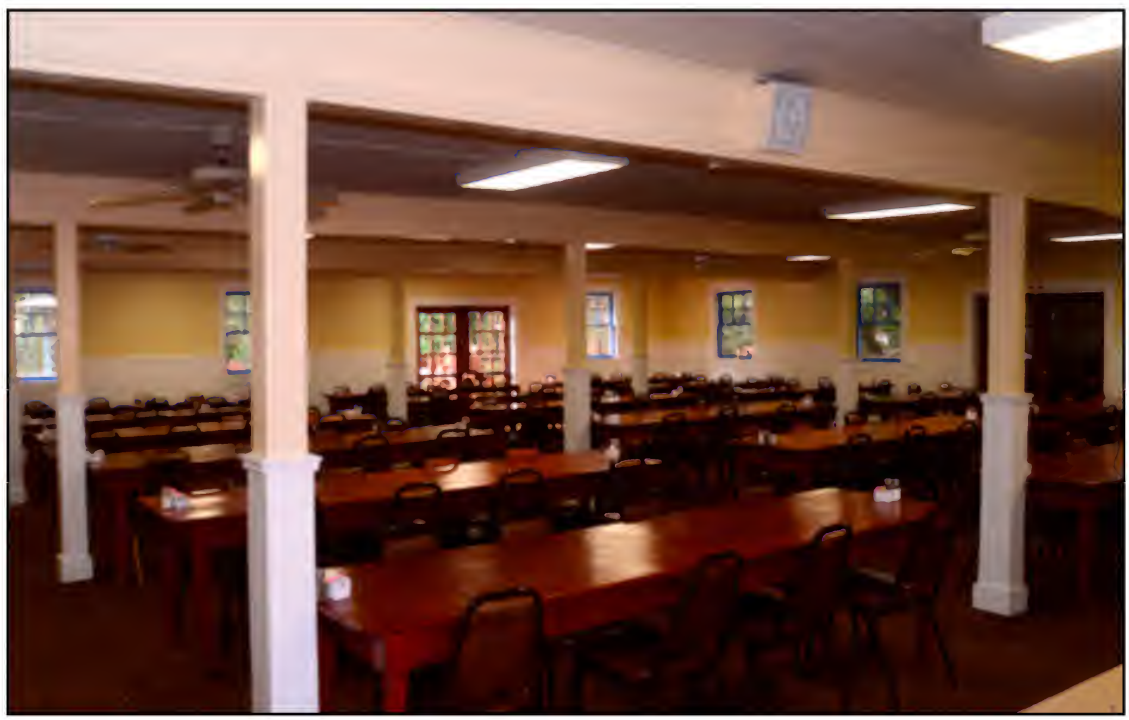


Gemma is associate professor in the Department of Microbiology and Molecular Genetics, Michigan State University and an Associate Blogger at Small Things

It is not too late to sign up for the upcoming NAMA Foray at Mission Springs in Scott's Valley, California (December 13-16, 2012). See http://www.namyco.org/events/NAMA2012/index2012.html for registration information. (*Photos: Noah Siegel)*



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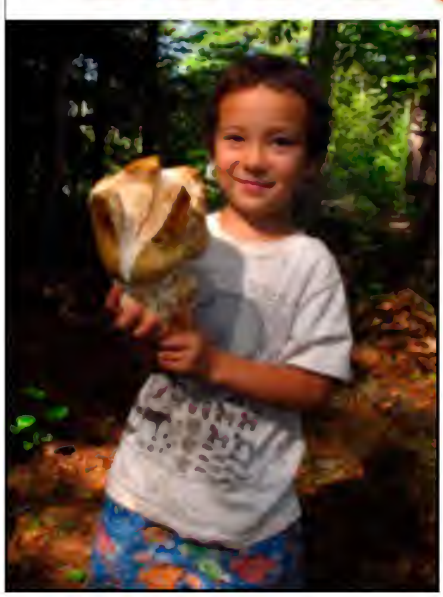

Five year old Linnaeus Orlov found this giant matsutake. According to David Spahr, who took these photos, "Linny knows mushrooms and wild plants better than 95% of all adults." The cap was pressed against a fallen tree, which accounts for its unusual shape. Linny's father is master matsutake hunter Jamie Waines.

Photos: David Spahr